military to a civil one was disclosed in the sundry civil appropriation bill reported in the House last Saturday. It provides for the appointment of a civil force of 111 persons in the office of the Chief Signal Officer, with an aggregate compensation of $114,500 a year, and this force it is proposed to substitute for the present military one of 150 men, and so save an expense of $70,748 a year.

THE EFFICIENCY OF MECHANICAL ENGINEERING SCHOOLS.[1]

WHEN the alumni of a school of engineering meet in annual reunion and conference, it is but natural to select for discussion a subject the serious deliberation of which will, to some extent at least, advance alike the interests of engineering practice and of the technical school itself. The technical graduate, who loves his profession and his alma mater, must deem it a wish of his heart to further in every way the harmony between the training and the practice of the engineer, to raise the efficiency of both the practice and the school to the highest attainable standard.

Happily, it is a fact that each day the value and importance of the technical school are becoming better appreciated, and that at this time none are readier to acknowledge the benefits conferred by systematic training in such schools than the leading engineers, who, without such preparation, have by their individual, unaided efforts, risen to deserved prominence and fame. Such general appreciation is recognized in the spoken and written word of the foremost men in the profession, in the fact that they send their sons and advise young men seeking to become mechanical engineers to attend these schools, and in the marked preference shown in the employment of the technically trained engineers. That these are facts is a cause for congratulation, a testimony to the value of systematic study, and an evidence of at least an average efficiency on the part of the leading schools of mechanical engineering. It is a great advance upon the time, not so long ago, when it was presumed that the main thing — and the first thing — the technical graduate had to do was to unlearn almost every thing he had acquired in the schools.

While we should be duly grateful that the status at the present day is such as we have pictured it, we must not conclude hastily that the technical school is fulfilling its entire mission, or, if I may so term it, attaining an efficiency of one. I am well aware that this would be asking too much; for what device, scheme, or appliance can show up this efficiency? At the same time the technical school should approach this limiting value of the perfect device as nearly as possible, and we should study the sources of loss, so as to reduce the losses to a minimum.

Such is naturally the main object of the serious work of alumni meetings, and the president's address should at least serve as an incentive to direct special thought on the part of the membership to these particulars.

From this point of view, the inquiry has suggested itself to me as worthy of our consideration, has the instruction in schools of mechanical engineering, within the past twelve years, progressed so as to conform to the increasing needs called for by the engineering advances secured within the same time?

In a paper read last month before the American Society of Mechanical Engineers, one of the members, who has practically contributed to the progress of the printing-press, presents 'A Plea for the Printing-Press in Mechanical Engineering Schools.' It is an honest plea, courteously uttered, and with an evident desire in no way to disparage the value of the training secured in engineering schools. The writer maintains, that while the printing-press shares, perhaps, alike with the steam-engine the fame as a great civilizer, no attention is given to it in any specific way in the leading engineering schools; that no books relating to it are studied or referred to, no lectures delivered detailing its mechanism; that its factories are not inspected by the students; and that no sample machines adorn the schools' laboratories of engineering. All this is inferred by the writer from a perusal of the catalogues. Usually, judgment as to the course of studies pursued, if based solely on the catalogues themselves, is a dangerous procedure, apt to lead to fatal errors; but in this case no mistake is made, for it is a fact that the printing-press receives but little if any attention in the engineering schools.

Had our friend, the writer, been interested to draw the picture of neglect of subjects discussed still further, he would have soon discovered that small attention, if any, is paid in the course pursued in engineering schools to type setting and distributing machines, paper-making machinery, envelope-machines, sewing and stitching machines, which are allied closely with the printing-press as civilizing agents. And if he looked over the many practical industrial engineering fields, he would have had to come to the conclusion, that, as a whole, but little if any attention is paid to hat-making, cloth-finishing, brick-making, and agricultural machinery, and the like, and that even the looms of various nature come in for the most cursory attention.

Had this been done, the amount of neglect discovered would have been so appalling that he would logically have been forced to one of two conclusions, — either that his point of view and solution were not the proper ones; or that mechanical engineering schools are essentially a failure, and not in one whit entitled to the credit which he really liberally bestows, when having but the one practical omission in mind, and not the many others, no less important ones, only a few of which we have enumerated.

Had the latter conclusion, condemning the schools as a failure, been reached, it would, in my judgment, have been a totally erroneous one.

Still the fact remains that within the past twelve years (and I only name this period because it is the term in which, since graduating from Stevens, I have followed more closely and played my humble part in the current of events) the progress made in most of the individual engineering and mechanical pursuits has been tremendous, while entirely new industries have called for new engineering appliances, and, *vice versa*, new inventions have developed new industries.

What should be the relation of the course of study pursued in the schools of mechanical engineering to these ever-increasing important industrial engineering applications?

Should every new, important mechanical device, especially if it brings with it new fields of practical employment and labor for the engineer, immediately find its place as a study in the engineering school?

If this be so, the school of mechanical engineering will have to extend its term of study to an indefinite extent; and ere long it will come to pass that the young student, entering as a beardless youth, will graduate from the school as a gray-haired man in the decline of life: for, surely, if every important machine is to be the subject of special study in the technical school, a lifetime will only suffice to cover the ground. And the result?

The result would be that the engineering schools would be of no use to the world; for the world's engineering work would be being done by outsiders, while the gray-haired students, plodding along, would be kept busy studying this very work, and not be active agents in its development.

I have purposely drawn this picture from an extreme point of view, for such method often enables us to discover what the fundamental truth underlying the problem really is. I think, in this case, the truth is apparent at once.

It is the mission of the technical school to inculcate the principles of engineering, to train and mature the powers of observation and mechanical judgment, and, after teaching the laws of physics and mechanics, to give the ability to apply these laws to problems arising in machinery and the industrial arts. The special machines and appliances dwelt upon in the school should serve this one purpose: a knowledge of them should not be the end, but the means. Because we can best inculcate and supplement a correct understanding of the physical laws, and a knowledge of how to apply them to the design of machinery, by studying the successful applications made, therefore such study should form an important factor in the course of the technical school.

These engines, motors, machines, factories, and engineering works should serve as the constant tests and checks of the student's efforts at individual design. When the student has once acquired the ability to put physical principles and experimental data

[1] Presidential address delivered by Alfred R. Wolff, M.E., before the Alumni Association of the Stevens Institute of Technology, June 13, 1888.

into the best engineering forms, bearing in mind economy of material, with least sacrifice of strength, best method of handling, management, and the like, he comes equipped to struggle with new machines of which he has had no previous special knowledge. The school cannot give to the student all this desirable latent power, or stored energy, for much of it must come in later life from individual, unaided effort; and the experiences of daily application (often coupled with some degree of failure) must be the teachers which never leave the side of the devotee of engineering science. But these teachers are most efficient, if the student has been trained in the engineering school both and ever to reason before beginning work, and to check his previous reasoning by the results secured.

If we regard the technical school from this aspect, it is plain why the various prime movers play so important an element in the course of instruction, to the disadvantage of other possibly equally important machines.

They are the most direct applications of very important and leading laws of physics; and the intelligent discussion of the prime movers calls for quite a knowledge of these laws, both in experimental and mathematical form. The problems of mechanics are splendidly embodied in the design of the various parts, and in many diverse ways, modified as is the application by the strains to which the parts are submitted, the strength of the materials, and the practical methods of their working. Every conceivable strain, simple and compound, since it enters the working of the steam-engine, for instance, comes up for consideration, while all the leading materials enter its construction. The prime movers act as fine checks on the student's individual efforts at design, for they represent the embodiment of centuries of application and development by the best engineering talent. They give opportunity for experimental verification of the laws of physics and mechanics as well.

In other words, I maintain that the main reason why the prime movers play so important a factor, and occupy so leading a part, in the course of study of a technical school, is not directly because they are such great civilizing agents and have so wide an application, but because they serve, as above indicated, as the best method of study for the incipient engineer. I do not think that the latter point has been sufficiently analyzed, emphasized, and made clear, certain as I am that you will agree with me as to its importance and truth.

And it is for the same reason that other far-reaching machinery, such as I have mentioned, great as is its use, and important as is its development, can have but little time devoted to its study in the technical school. It is because, as engineering exercises, these machines do not equal the prime movers; and saving of time commands that the best exercises be adopted. If the prime movers were far less important industrial factors than they really are, their study would, in a well-regulated course of engineering, which is planned not as an advertising medium, but is based on the principle of serving the student best, be just as important a matter and as conspicuous as is the case to-day. I think the point of view that the machinery discussed in the schools should be the educational means, should be the exercises adopted for testing and furthering a knowledge of the laws of physics and mechanics, as embodied in design, is an efficient answer to much of the criticism of the class to which we have referred.

If it be insisted on, that the reason so much time is devoted to the prime movers (notably steam-engines) is because of their general application in all industries, I will admit that this may have been the cause why originally they were put down for so much attention. Had it then, however, not been shown that they serve as well as the best exercises in the application of the laws of physics, mechanics, and design, they could not have held their place, and would, long ere this, have had to give way to the study of other devices of less wide application which answered the educational need better.

I fully appreciate the view that it is commendable, indeed desirable, that the students, when graduating from technical schools, should possess some general knowledge of the leading machines in the market; but the first essential thing is, that they should have acquired the ability to be useful workers in every field by being possessed of a knowledge of the principles and methods of procedure which underlies all engineering works and machines and their design.

At the same time let us not be slow to learn all we can from criticism honestly advanced; and so, while I do not deem it an essential matter, I say (cost, room, and time permitting) it were well, perhaps, if some few important machines, now totally neglected, could find some place as types in the engineering laboratories, and receive some brief attention by visits to the factories, or, in some cases, by evening lectures delivered by specialists. To a limited extent this might prove, it appears to me, a proper field for non-resident lectureships. It is indeed a question whether such lectures on special machines not at all studied in the school, delivered by acknowledged experts, would not prove more useful than the growing practice of having matters that are gone over in detail in the regular course reviewed hastily in brief discourse by leading engineers. In the nature of things, these outsiders are apt to be at sea in point of exact information as to the extent of preparation and acquisition of their hearers, the students, in the special subject under discussion, and thus are led to indulge in the dispensation of elementary information or fruitless generalities, which add little or nothing to the students' knowledge or ability.

But, before even this special lecture course is undertaken, we should make sure that any time which can be gained cannot be more advantageously employed in a more thorough course of the prime movers themselves; for to-day it is a common experience and regret, on the part of professors of engineering, that they cannot find in the crowded curriculum much needed leisure to devote to some important educational problems in design and applied engineering which these prime movers offer.

The general view that time is an important factor, that the best attainable must be accomplished within a given time, and those exercises be adopted which will serve as the best means of furthering a knowledge of the principles in their engineering aspect, and, furthermore, the desirability to embrace every thing of real importance in the course, makes it a vital matter to constantly scrutinize and keep close watch on the course pursued, in the hope of discovering whether some matters studied might not be omitted or advantageously modified, so as to give spare time to the essential.

Regarding it from this aspect, it has occurred to me that some of the theoretical preparatory studies pursued, such as mathematics, physics, chemistry, and the like, — and I purposely omit languages, belles-lettres, and those general academic branches having a less intimate connection with the engineering course, — seem not to be carried out in some particulars so as to secure the highest efficiency from an engineering point of view.

Let me call your attention to this point. Is it not remarkable that essentially the same text-books on physics, chemistry, analytical mathematics, descriptive geometry, and the like, are studied at engineering schools as at the ordinary academic course of a university? Does not this fact of itself almost imply that the studies, as pursued, are not made to specially adapt themselves to the needs of the applied studies of the engineer? Could not some abstract developments, now dwelt upon at length, be advantageously omitted, while physical experiments and applications in heat, electricity, and the like, be more copiously introduced as exercises, both with the view of imparting a thorough hold on the abstract taught, and also as imparting requisite useful information and methods of procedure? It is my opinion, that, in the application of mathematics to physical problems, even the mathematician, and certainly the engineer, can best test and master a knowledge of the mathematics themselves.

How common is the experience of those who, having acquired in the usual way, even from the best of masters, what they considered a pretty fair hold on calculus, — and this embraces the experience of many gifted students, — when they tried to apply this knowledge in the study of the mechanical theory of heat, found they really had no thorough grip on the calculus, as they had presumed, and had, in fact, to start anew, with a decided loss of time, which might, it seems to me, have been avoided!

I concede the value as fully, and am as anxious as any one to guard the pursuit of knowledge in the abstract on its own account. Still, I say, why not in plane, solid, descriptive, and analytical geometry, and in calculus and other analytical mathematics, gain

some time now devoted to the elucidation of abstract propositions, and detailed elaborations in various forms of the same propositions, of no direct value, and some time now devoted to applications, which, designed to test the understanding, are really essentially numerical substitutions, so as to find leisure to supply physical problems as a test? The latter problems best serve to call forth a true knowledge of the principles. It is only in such application that we discover whether we have really grasped and actually secured the full meaning of the principle. So, too, in the course of physics as pursued in mechanical engineering schools, some details now studied, from force of habit and as being the regular thing in a complete course of physics, might, it appears to me, be advantageously omitted, and replaced by special and more extended work in heat, electricity, elasticity, and the like.

Surely, I trust, this will not be misinterpreted as a plea for the abandonment of study of abstract principles. The abstract principle is to be thoroughly studied, and the application is designed to insure the full comprehension of the principle. But why not select as far as possible, and dwell mainly on, such abstract principles, which can be re-enforced by these physical tests, and select such practical physical exercises, experience in which will re-act alike most directly to the comprehension of the abstract, and as desirable preparatory knowledge for the engineering course?

This is the only solution, if a four-years' course is to suffice; and, furthermore, it is in direct accord with the principle which underlies the engineering instruction, and which permits us to pay little attention to many fine important engineering devices, such as the printing-presses, agricultural machinery, and the like.

You will readily appreciate that this insertion of proper exercises, this working-out of special text-books and courses of study in the various elementary sciences, forming the foundation and most of the first two years' course of the mechanical engineer, applies to the several branches taught. I cannot burden this already too long address with details in the several departments; but there is, it appears to me, no great difficulty in discovering them when careful search is made.

If the point here emphasized would be borne in mind more steadfastly than is now the case, I believe time could be saved in the two later years, when the deficiency outlined must be then supplied as best it can, and some further exercises bearing on useful applications in design, and special lectures now crowded out, could find room.

If I have dwelt on the time available as an important factor in the educational problem, it is not to be interpreted as a favoring of undue haste. Better acquire some things thoroughly than a greater number superficially, for only in thorough acquirement can habits of correct observation and matured judgment be formed.

If I pointed out that in the two years' preparatory work of the course in an engineering school the general scheme seems to me, as far as I have been able to follow the matter, to be essentially the same during the past twelve years, while the fact of the rapid developments in applied engineering does make it important to consider some matters, at least from a general point of view, not necessary to consider at all twelve years ago, it is not to be construed as a sweeping criticism of this preparatory course. Such course is in my opinion, on the whole, admirable, but I believe it could be improved in the particular named. At the same time I am aware that a practising engineer, who only gives thought to these educational matters now and then, is apt to underrate the progress made; which progress may, in fact, be much greater than he anticipates, and perhaps even in the very line of the criticism advanced. If it be thus, so much the better that these words be uttered at the alumni meeting of the leading school of mechanical engineering in the country, where the presence of the faculty and their participation in the discussion will speedily lead to rectification of the error, if such it be, and to the enlightenment of those graduates and others who share the views just set forth.

In closing, let me emphasize that what I have said is meant to apply not specifically to our own alma mater, but to mechanical engineering schools in general.

THE conferring of degrees at the close of the twelfth academic year of the Johns Hopkins University took place June 14.

THE ETHNIC POSITION OF THE BASQUE NATION.

THE Basque or Euskarian people of the Pyrenæan and Cantabrian ridge are supposed to count at present about six hundred thousand souls. Four-fifths of them live on Spanish territory. They are well-proportioned in their bodies, but rather small, so that a large percentage have to be excluded from military service. Most of them are of a dark-brown complexion, although blondes are not scarce. Their faces are oval, their features agreeable, their general health excellent; and "to run like a Basque" has become a proverbial locution throughout the south-west of Europe. Among the Spanish Basques the dolichocephalic type is almost the only one observed. These and other ethnologic points form the introductory to a learned article by Prof. G. Gerland, 'The Basques and the Iberians,' inserted in the first volume of G. Gröber's 'Grundriss der romanischen Philologie,' one of the best encyclopedic works that ever appeared on the Romance languages of southern Europe (1886, pp. 313–334). The peculiar social and legal customs of the Basques, our author continues, make of them a people with archaistic survivals of various kinds, but do not by any means prove them to be an ethnologically isolated race. But their peculiar language shows them to be distinct from any other nationality. Some said that the 'Vascuence' was the language spoken in Paradise, while others believed "that even the Devil could not acquire this tongue." The sound *f* is wanting in all its dialects, and the language belongs to the agglutinative type. The radices are all monosyllables, or reducible to such, verbal roots being made clearly distinct from nominal roots. Basque is a pure suffix language, prefixes being unknown: even the definite article 'a' is postpositive. The language is not sex-denoting, except in the pronoun. The inflection of the transitive verb differs from that of the intransitive, but in both is mainly carried on by auxiliary verbs. The large number of verbal conjugations established by the earlier grammarians chiefly rest on the various direct and indirect pronominal objects that may become connected with the verb.

All these distinguishing traits of the language separate the Basque from the Celts as well as from the Romans; but whether they separated them also from the old Iberians is the problem which Gerland (and so many others before him) has tried to solve. The reports of the ancients upon the popular customs of the Iberians wholly coincide with what we know of the Basques of to-day; but a much more stringent proof lies in the fact that the ancient local names of the largest portion of Hispania, then inhabited by the Iberians, can be explained through the Basque language only. This region of Basque local names also extended over Aquitania in south-western France; and it is a striking fact in favor of this theory, that the present Gasconian dialect does not know the sounds *f* and *v*, for the Gascons are nothing else but Romanized Basques, and the tribal name of the ancient Ausci in those parts is the radix of the name 'Euskarian.'

That the Iberians, or ancient Basques as we may call them with Gerland, formed a unit as to their language and ethnic peculiarities, is evidenced by the fact that the Spanish language was evolved in homogeneous, uniform manner throughout the peninsula, whereas in France and Italy the ethnic difference of the inhabitants has produced dialects in the north and south which are opposed to each other, just as so many different languages. Although an immigration of Celts about 530 B.C. produced a race called Celtiberians, the manners and customs have remained Iberian with small modifications, and the dialectic differences among these were probably inconsiderable. Among the Iberian features which have impressed themselves upon the Spanish people, Gerland counts the bigotry and fanaticism of the Church, and the fondness for audacious, adventurous maritime expeditions.

While enumerating Basque terms which have found their way into the Spanish literary language, Gerland very pertinently remarks that barely one-third of these is found in the Portuguese, but that several had entered into the Hispano-Roman dialect at the time of the Roman domination. The Latin tongue has undergone less alterations in the Spanish language than in any other of the Romance languages of modern times. This is explained by Gerland by the fact that the Basque then spoken in the country was too heterogeneous for having much influence on the phonetics and morphology of the new language then in course of formation. The